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(71) Applicant  
Pearpoint Limited

(Incorporated in the United Kingdom)

58 Woolmer Trading Estate, Bordon, Hampshire,  
GU35 9QF, United Kingdom

(72) Inventor  
Alan Keith Sefton

(74) Agent and/or Address for Service  
Gee and Co  
Chancery House, Chancery Lane, London,  
WC2A 1QU, United Kingdom

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(54) T.V. camera with tilt/pan effect

(57) A scanning T.V. camera has a wide-angle lens 15 and incorporates a CCD sensor 14 in the focal plane of the lens. The sensor is mounted for movement in said focal plane under the action of an arm 20 which is accommodated within the dimensions of the camera and which is universally mounted at its proximal end 21 with its distal end 19 engaging said sensor.

The sensor is carried in a PTFE bearing 16 which slidingly abuts a pane 17 of optically clear glass, and has a universal connection 18 to receive the distal end of said arm. Movements of the arm are produced by two electric motors 23, (24, Fig. 2) which are also accommodated within the dimensions of the camera and are arranged to pivot the arm about the X-axis and the Y-axis respectively. The arm is centrally mounted and is telescopic to accommodate change in length as the sensor is shifted towards and away from its central position.

The camera is primarily intended for inspection of inaccessible areas, and transmits to a remote T.V. monitor. Preferably, encoders are coupled to the shafts of the motors to feed back positional information to the monitor.

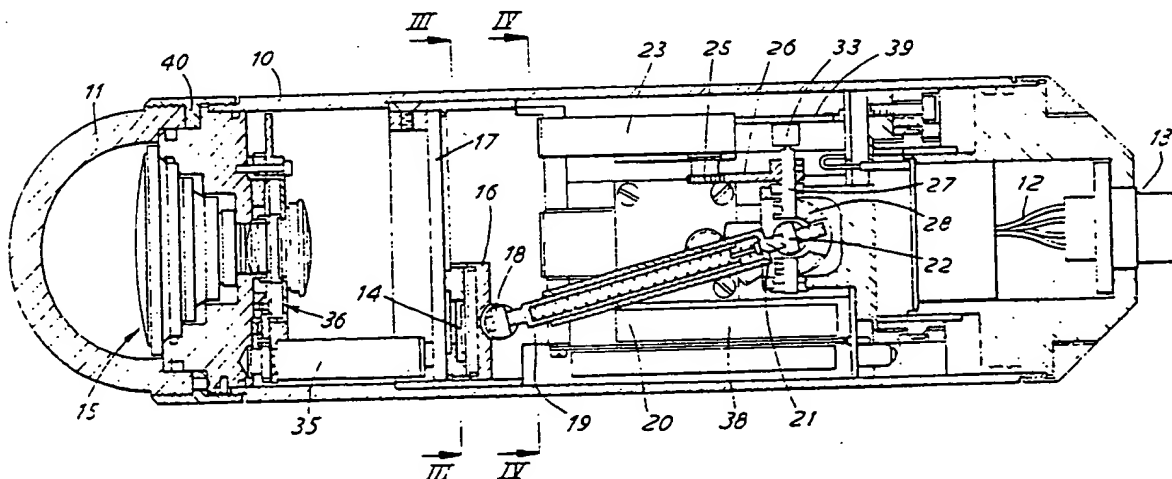


FIG. 1

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

The claims were filed later than the filing date within the period prescribed by Rule 25(1) of the Patents Rules 1982.

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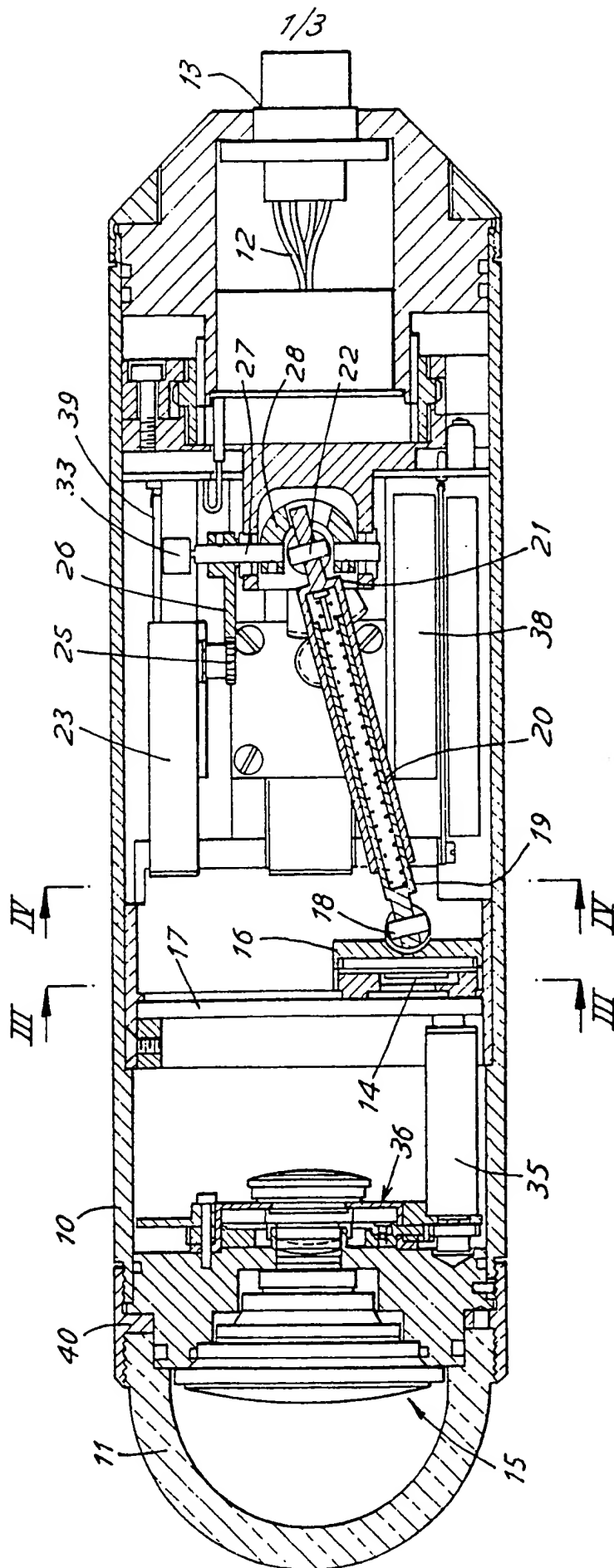


FIG. 1

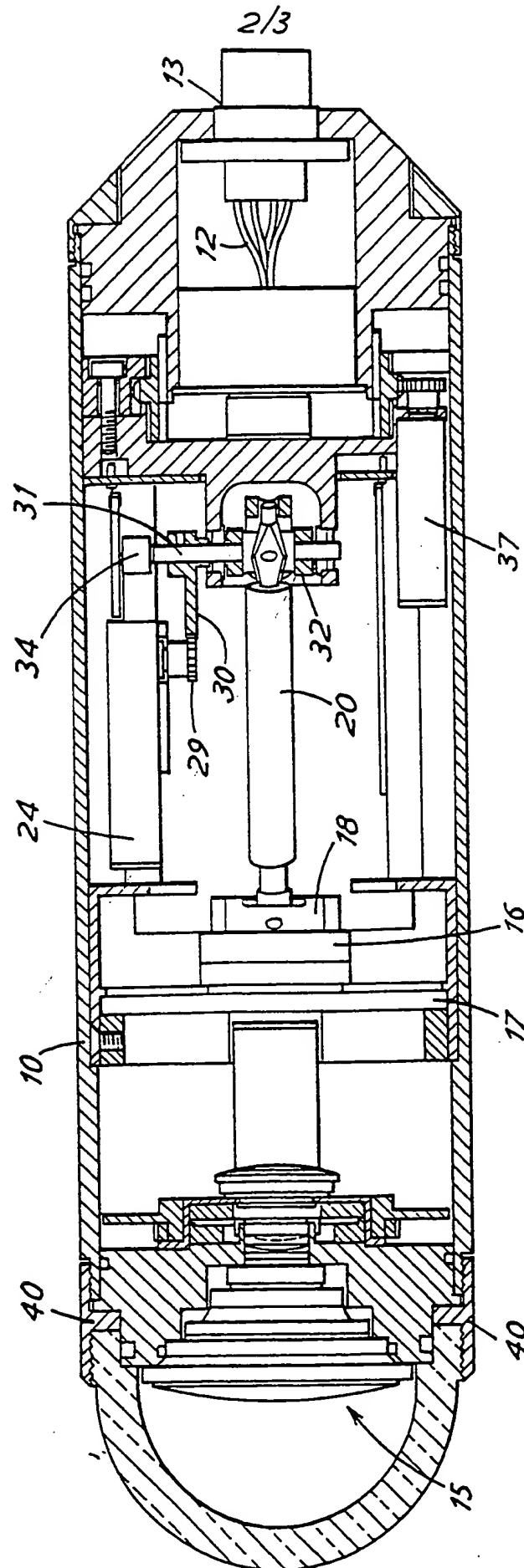
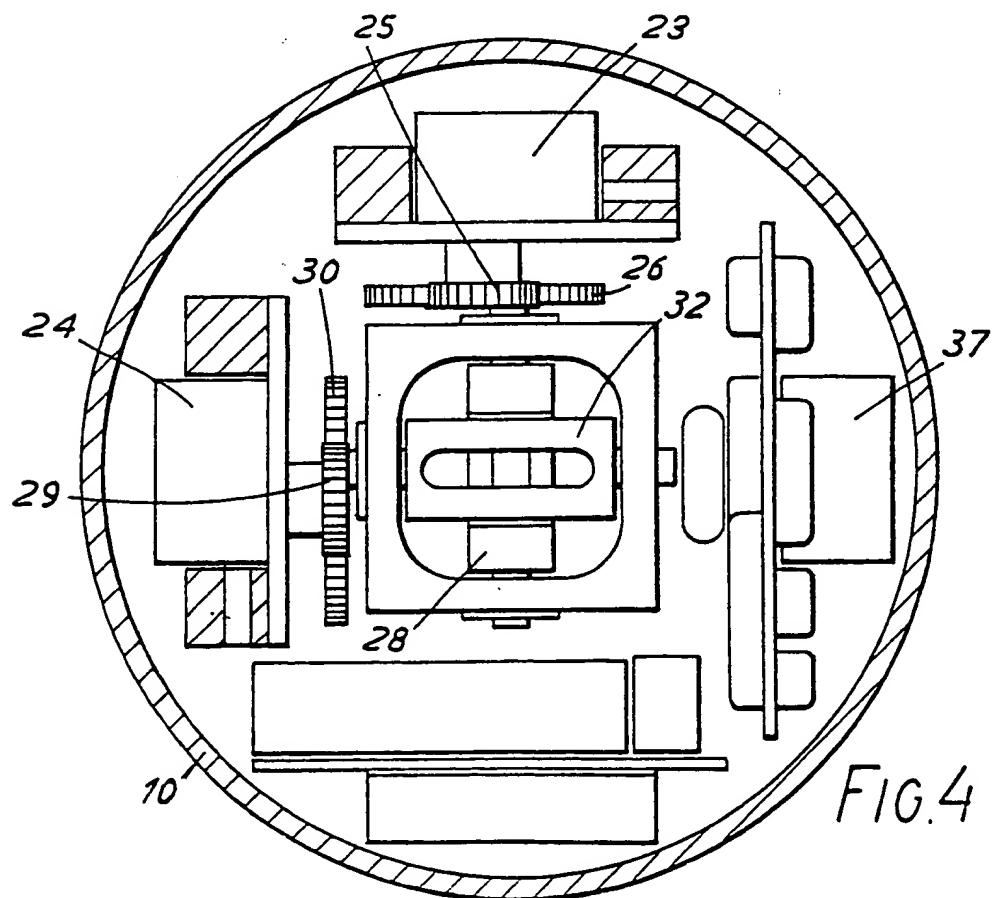
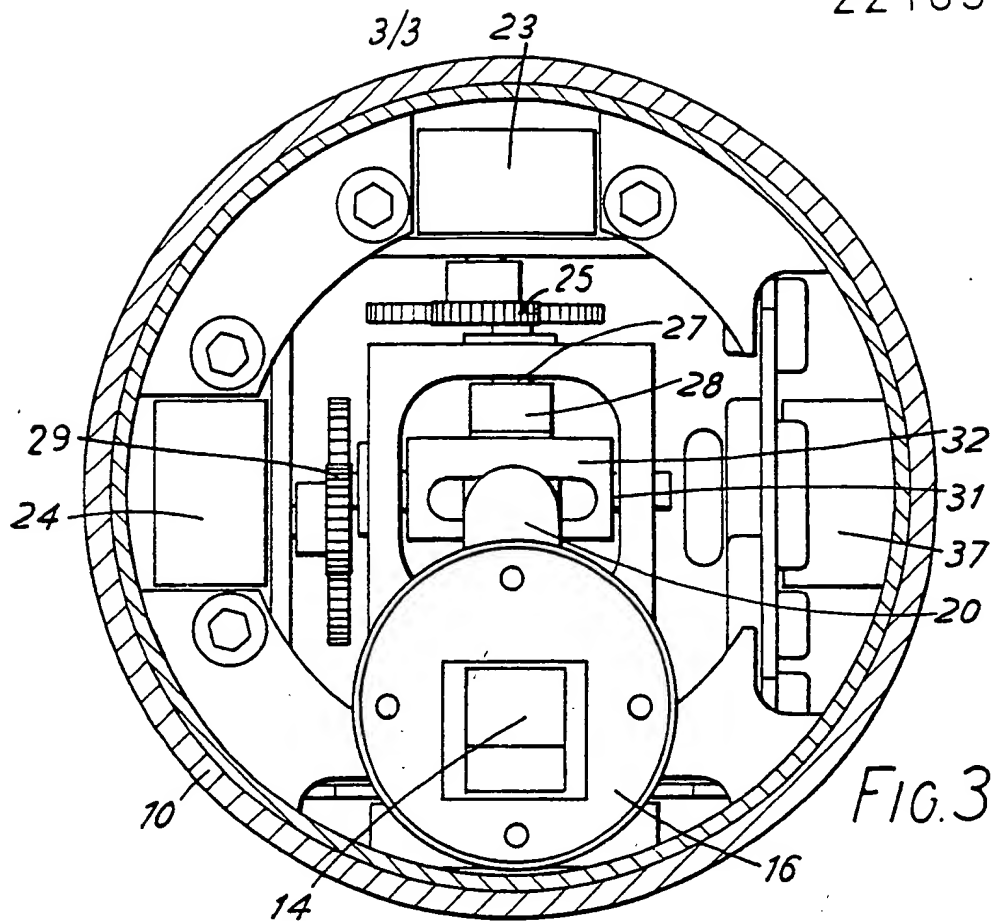


FIG. 2

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T.V. CAMERA WITH TILT/PAN EFFECT

This invention relates to cameras, and particularly to T.V. cameras which incorporate a CCD sensor and are required to produce a tilt/pan effect.

5 The T.V. camera of the present invention is intended for use in inspection, particularly in the inspection of relatively inaccessible areas such as the interiors of sewers and other pipe-lines, and also in other applications such as surveillance.

10 Cameras for this purpose should have a wide field of view, usually incorporate a wide-angle lens, and are provided with operating mechanisms to effect scanning of the area to be inspected. T.V. cameras usually now incorporate CCD (charged coupled device) sensors, and the sensor can be shifted on the X and Y axes to produce the  
15 tilt/pan effects for scanning. It is an object of the present invention to provide a T.V. camera of the above kind which has an improved operating mechanism for effecting X Y shift of the sensor.

20 According to the present invention, there is provided a scanning T.V. camera having a wide-angle lens and incorporating a CCD sensor in the focal plane of the lens, characterised in that the sensor is mounted for movement in said focal plane under the action of an arm which is accommodated within the dimensions of the camera and which  
25 is universally mounted at its proximal end with its distal end engaging said sensor.

The sensor is preferably carried in a PTFE bearing which slidingly abuts a pane of optically clear glass, and has a universal connection to receive the distal end  
30 of said arm. Movements of the arm are preferably produced

by two electric motors which are also accommodated within the dimensions of the camera and are arranged to pivot the arm about the X-axis and the Y-axis respectively. Preferably also, the arm is centrally mounted and is telescopic to accommodate change in length as the sensor is shifted towards and away from its central position.

An important advantage of the inventive construction is that no external drive mechanisms are involved, and so the camera can be compact and streamlined to facilitate passage through a conduit which may be restricted and at least undulating. The compact and streamline features are also attractive in surveillance cameras which must often be of minimum size and which are also desired to be of pleasing appearance.

Embodiments of the present invention will now be described, by way of example, with reference to the accompanying drawings in which:

Figure 1 is a vertical sectional elevation showing a T.V. camera according to the present invention,

Figure 2 is a horizontal section corresponding to that of Fig. 1;

Figures 3 and 4 are transverse sections, generally on lines III - III and IV - IV of Fig. 1 and enlarged.

Referring to the drawings, the camera has a cylindrical, hermetically-sealed casing or body 10, and a hemispherical transparent dome 11 is screwed onto the front end of the body. Electrical leads 12 extend to a socket connector 13 at the rear end of the casing. The connector is for a power source to operate the camera and to energise optional lamps (not shown) which may be attached to the camera body, and for a remote T.V. monitor (not shown).

The camera itself is of generally conventional form, incorporating a CCD sensor 14, and having a multi-element fish-eye lens 15 with 180° range. The sensor, which lies in the focal plane of the lens, is carried in a PTFE bearing 16 which slidably abuts a pane of optically-clear float glass 17. A central universal coupling 18 at the back of the bearing receives the distal end 19 of a telescopic arm 20 which is mounted at its proximal end 21 in a universal bearing 22.

10        Electric motors 23 and 24 are provided to pivot the arm 20 in the directions of the X-axis and the Y-axis and so shift the sensor 14 carried in its bearing 16. The motor 23 drives a pinion 25 which turns a plate gear 26 mounted on a shaft 27 which pivots a yoke 28 to swing 15 the arm 20 along the direction of the X-axis (Fig. 1). The motor 24 drives a pinion 29 which turns a plate gear 30 mounted on a shaft 31 which pivots a bearing 32 to swing the arm along the direction of the Y-axis (Fig. 2).

As the arm is swung by the two motors, the bearing 20 16 and thus the sensor 14 is shifted across the focal plane of the camera lens. The arm is telescopic to accommodate variations in length as the sensor moves, and spring-loaded to retain engagement with its end connections.

Encoders 33 and 34 are coupled to the shafts 27 and 25 31, to provide a feed-back of positional information for the T.V. monitor display. This informs the user of the section of the (hemispherical) field of view which is being inspected.

A third electric motor 35 is provided to operate 30 iris mechanism 36 of the lens 15, and a fourth motor 37 is provided for focus adjustment of the image device relative to the lens assembly.

Reference 38 denotes a logic/buffer of the camera electronics system, and reference 39 denotes a P.C.B.

Cameras of this kind are preferred to operate in a substantially inert atmosphere and, for this reason, the casing is charged with dry nitrogen. It will be noted that the casing is hermetically sealed and, due to the provision of shaped-section ring seal 40, the dome 11 can be removed, as indicated in Fig. 2, for cleaning or replacement without disturbing the nitrogen charge.

10       The scanning camera described above provides a compact and streamline unit, with a simple but precise internal operating mechanism which can readily be passed through a conduit - possibly by means of the semi-rigid FLEXIPROBE conductors. The camera permits scanning over its hemi-  
15       spherical 180° field of view, with automatic identification of the section being scanned; the overall field of view is determined by the lens which has a possibly variable focal length and provides an image format which is larger than the image format of the sensing device.



CLAIMS

1. A scanning T.V. camera having a wide-angle lens and incorporating a CCD sensor in the focal plane of the lens, characterised in that the sensor is mounted for movement in said focal plane under the action of an arm which is accommodated within the dimensions of the camera and which is universally mounted at its proximal end with its distal end engaging said sensor.
2. A scanning T.V. camera as claimed in Claim 1, in which the sensor is carried in a PTFE bearing which slidingly abuts a pane of optically clear glass, and has a universal connection to receive the distal end of said arm.
3. A scanning T.V. camera as claimed in Claim 1 or Claim 2, in which movements of the arm are produced by two electric motors which are also accommodated within the dimensions of the camera and are arranged to pivot the arm about the X-axis and the Y-axis, respectively.
4. A scanning T.V. camera as claimed in any preceding Claim, in which the arm is centrally mounted and is telescopic to accommodate change in length as the sensor is shifted towards and away from its central position.
5. A scanning T.V. camera as claimed in any preceding Claim, in which the camera has a hermetically-sealed casing, and a transparent dome is removably secured to the leading end of the casing to provide an external shield over said lens.
6. A scanning T.V. camera as claimed in any preceding Claim, in which said lens is a fish-eye lens.

7. A scanning T.V. camera as claimed in any preceding Claim, in which said arm is mounted at its proximal end on a universal coupling.

8. A scanning T.V. camera as claimed in any preceding Claim, in which said lens is incorporated in a lens assembly and an electric motor is provided to adjust the iris of said assembly.

9. A scanning T.V. camera as claimed in any preceding Claim, in which said lens is incorporated in a lens assembly and an electric motor is provided to adjust the focus of said assembly.

10. A system for scanning relatively inaccessible areas, comprising a T.V. camera according to any preceding Claim, and a T.V. monitor to receive signals from the camera, wherein means are provided to feed back positional information from the camera to the T.V. monitor.

11. A scanning T.V. camera, substantially as hereinbefore described with reference to the accompanying drawings.

12. The features herein described, or their equivalents, in any patentably novel selection.